Improved furrow sowing for water repellent soil

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Purpose:	To assess the impact of different seeding systems on crop establishment in water repellent soil
Location:	Badgingarra
Soil Type:	Site 1: Sandy gravel and Site 2: pale deep sand
Rotation:	Site 1: Canola 2009; Wheat 2010 Site 2: long-term pasture
GSR:	485 mm (BRS weather station)

BACKGROUND

When furrow sowing was first developed for water repellent soils in the early 1990's most of the seeding was being done with sweep or winged type points which tended to grade the water repellent soil out of the furrow into the ridges. There has been widespread adoption of knife points for seeding since the mid 1990's. Recent observations have noticed that in many cases the furrows in water repellent sands were not wetting up and remaining dry resulting in patchy crop establishment. Subsequent assessment has confirmed this finding that with knife point seeding systems soil moisture in the furrow is often drier than the ridge and the soil in the furrow is more water repellent than it is in the ridge. It is hypothesised that this problem may be due to dry water repellent soil falling behind the knife point during seeding and into the slot with the seed and fertiliser ahead of the closer plate. This problem would be exacerbated by dry sowing and fewer and smaller rainfall events at the break of the season.

DEMONSTRATION DESIGN

The demonstration site was established on-farm and consisted of an unreplicated strip trial with a seeder with winged points and paired rows (Morris Contour Drill) being tested alongside the growers' normal knife point seeder (Morris 9000 single shoot no till). The same air cart, seed, seeding rate and fertiliser was used for each seeder type. In relatively small patches of strong and obvious water repellence paired measurements were used to determine differences in crop establishment and soil moisture content and while paired hand harvest cuts were taken at crop maturity used to assess crop growth and yield in these areas. Two areas of severely repellent sandy gravel and one area of moderately repellent pale deep sand were monitored and assessed. An overall yield difference between the two seeder types over a much larger area was determined using 600m long header harvest cuts and a weigh trailer. Crop yield at a second demonstration site comparing the same winged point-paired row seeder and a knife point seeder at Jeff Fordham's next to the West Midlands Group 2011 main trial site was also measured and reported here. At this site the knife point seeder was seeding at 85 kg/ha while the winged point-paired row seeder was seeding at 100 kg/ha. The same fertiliser types and application rates was used. Crop yield was determined using 4 replicate paired plot harvester cuts.

Machinery: Knife point seeder 9–inch spacing versus a winged point seeder with paired rows

8-inch inter-row spacing & 4-inch within the paired row (12-inch tyne spacing).

Crop details: Calingiri wheat @ 90kg on 1 June 2011

Fertiliser: **At seeding:** K Till Plus @ 100 kg/ha

Post: NS @ 85kg/ha (27 June); NS @ 85kg/ha (25 July); Flexi N @ 40 L/ha (12 August)

RESULTS

Table 1. *On-farm comparison of a knife point seeder compared with a winged point, paired row seeder on water repellent sand and sandy gravel at Badgingarra in 2011. Yield differences were determined from paired hand harvest index cuts.*

Soil type	Molarity ethanol droplet	Seeder type	Volumetric soil water (%)*		Crop establishment (plants/m^2)	Number of heads/m^2	Grain yield (t/ha)
			Furrow	Ridge			
Pale deep sand	1.5 moderate repellence	Knife points	—	—	97	180	1.19
		Winged points + paired rows	—	—	201	298	1.79
Sandy gravel	4.7 severe repellence	Knife points	2.2	4.8	95	299	3.98
		Winged points + paired rows	4.2	2.6	222	387	5.42

** Volumetric soil water measured once on 24 June, 2011.*

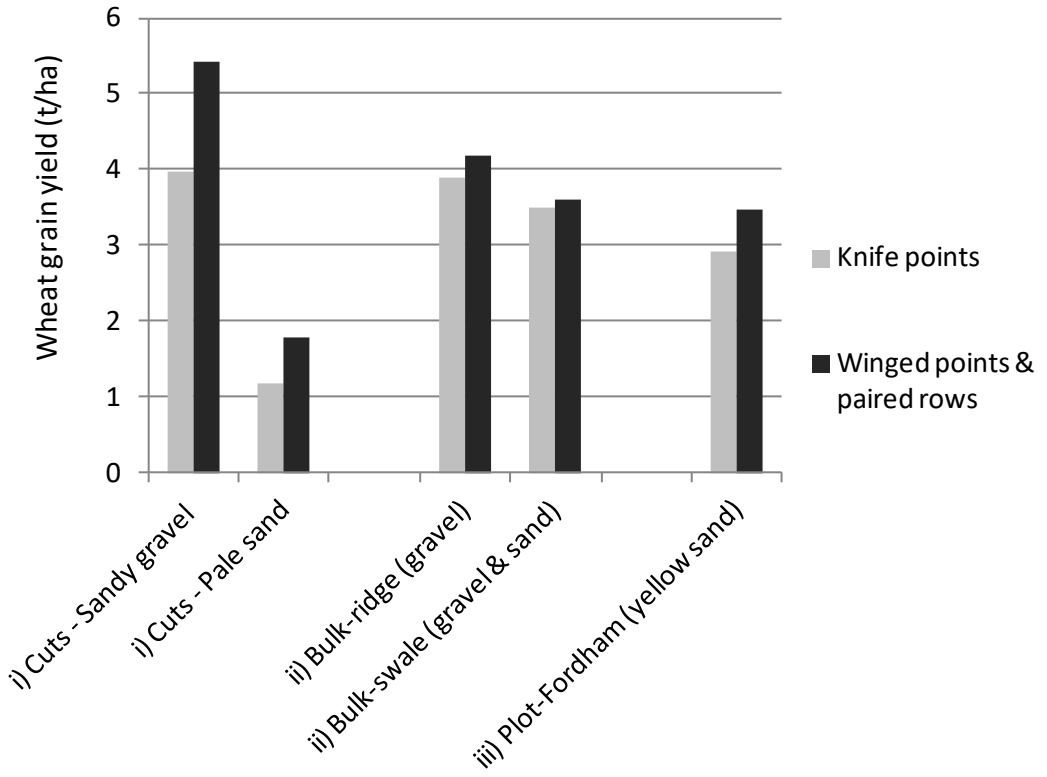

Figure 1. *Summary of wheat grain yields for knife point versus winged point-paired row seeder for: (i) hand harvest cuts (Cuts) on water repellent sandy gravel and pale sand; (ii) Header cuts (Bulk) 600 m long on the ridge with sandy gravel and in the swale with mixed sandy gravel and pale deep sand areas; and (iii) plot header cuts on yellow sand at Jeff Fordham's, near the West Midlands Group 2011 main trial site.*

DISCUSSION

In general for the bulk of the paddock in the wetter 2011 season there was little obvious difference in establishment between the knife point and winged point with paired rows seeder. However there were a several water repellent patches where establishment was poor for the knife point seeder but was much improved for the winged point-paired row seeder. Plant counts in these areas revealed that establishment was more than doubled from <100 plants/m^2 to >200 plants/m^2 through use of the winged point-paired row system in both the sandy gravel and pale deep sand soil types (Table 1). The paired row seeder effectively has 50% more seeding row so the chances of seed ending up in wet soil are increased. A one-off post-emergence measure of soil water content in the severely repellent sandy gravel revealed higher water contents in the furrow where the winged point and paired row system had been used compared to the knife point system (Table 1). In the knife points system the furrow was drier (2.2%) than the ridge (4.8%) with water content less than half what was measured in the ridge (Table 1). These observations are supported by other data from a research trial conducted at Balla in 2011, where wheat was sown with knife points without wings versus knife points with attached wings. Even though the seeding was done in wet soil conditions with only small areas of dry patch, the soil in the winged point furrow had a water droplet penetration time (WDPT) of 8 seconds compared with the soil in the knife point furrow that had a WDPT of 15 seconds.

The differences in crop establishment between the seeders flowed through to head numbers and grain yield (Table 1). The winged point-paired row system had 66% more heads on the pale sand and 29% more heads on the sandy gravel, while grain yield was increased by 50% on the pale deep sand and by 36% on the sandy gravel compared with the knife point system (Table 1, Fig. 1). It should be noted that hand harvest cuts can overestimate yields as there are no grain losses and sample sizes are small but it was visually obvious that there were significant differences between the seeding systems in these strongly water repellent areas. It was observed that weed populations in these water repellent patches were significantly less for the winged point-paired row seeder system compared with the knife point system due to better competition. Yield differences with the bulk header cuts were smaller, with an average yield gain of 191 kg/ha in favour of the winged point-paired row seeder (Fig. 1). Much of this yield difference may come from the persistent water repellent patches given the much larger yield advantage measured in these areas.

While it was not possible to determine which aspect of seeder design was most important from a seeder comparison it does demonstrate the type of benefits that an improved furrow sowing system can have in water repellent soils. It should be noted that knife point systems are a well-proven and very good seeding system and work very well on most soil types. However, our research and grower observation suggests they do not always work well on water repellent soils which are not fully wetted up and have patches of dry soil. Further field research will be conducted in 2012 to better understand the principles and alterations that can be made to improve furrow sowing in water repellent soils. Increasing the flow of water repellent soil out of the furrow through use of winged points or seeding boots, press wheel shapes that encourage stable furrows and use of banded wetting agents are key areas for investigation.

The advantage of improved furrow sowing as a tool to manage water repellent soils is it can be applied over all the repellent cropping areas, potentially for relatively low cost if only points and press wheels need changing on an existing seeder.

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